Space Weather Technical Forecast

Issued on Saturday, 15 January 2022 at 12:12 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: G1/Minor Storm intervals possible today.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low with several C-Class flares over the past 24 hours, the most recent a C4 flare at 0854UTC this morning from AR2932, at the NE limb. There are seven numbered sunspot regions currently on the visible disc, of which AR2932 as already mentioned is the most active at present. AR2929,and AR2930, located in the northwest quadrant, have shown growth but no significant flare activity. The four remaining sunspot groups, all located in the western hemisphere, are relatively small, simple groups having shown little activity this period.

No Earth-directed coronal mass ejections (CMEs) have been observed. The CME associated with the filament lift-off is currently not expected to be Earth-directed, although it is expected to pass close to Earth. However, as confidence is low regarding the CME some weak CME influence is possible at Earth late tomorrow or early day 3 (17th).

Solar Wind / Geomagnetic Activity: Solar winds as observed by ACE and DSCOVR at L1 started at slow-ambient levels, around 350 km/s, until around 14/2130UTC, then increased to slightly elevated levels, mostly between 430 and 470km/s. These increased levels persisted thereafter, with a peak of 490 km/s. Density of the wind was predominantly above average. Total interplanetary magnetic field (IMF) strength, Bt, steadily increased ahead of the HSS (High Speed Stream) to become strong, peaking at 18nT around 14/2111 UTC. The field strength then gradually returned to weak levels after midnight UTC. The Bz component showed a similar trend, reaching -17 nT at 14/2111, then gradually became weakly variable after midnight UTC. Phi angle was predominantly negative (towards the Sun). Geomagnetic activity was initially Quiet, but increased to Active (Kp 4) between 14/1800-15/0600, with a G1/Minor Storm (Kp 5) interval 14/2100-2400 UTC (as observed by BGS). Quiet geomagnetic conditions have returned since 15/0600UTC.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) remained at Background levels throughout, although a brief very slight enhancement was observed around midnight UTC. High energy electron flux (greater than 2MeV) was at background levels, temporarily reaching moderate levels of 165 pfu at 14/1545 UTC. Electron fluence remained well below the Active threshold (1e8 integrated pfu), with 1.56e6 integrated pfu recorded at 15/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be Low or Moderate, and further C-class or M-class flares are anticipated to continue from the newly numbered active region 2932 near the northeastern limb. Another region is also expected to rotate on from the far side, within the next two days, and this could also increase solar activity.

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Solar Wind / Geomagnetic Activity: No Earth-directed CME's are currently expected, although one CME is expected to pass close to Earth late tomorrow or early on day 3 (17th). The solar wind is expected increase further through today, likely becoming strong with speeds 600-650 km/s possible. The HSS influence is then expected to gradually decline from day 3 (17th) onwards. Occasionally Unsettled to Active (Kp 3-4) periods are likely today and through tomorrow, with isolated G1/Minor Storm intervals still possible, especially during the coming night and then to a lesser extend through Sunday night into day 3 (17th) due to possible weak CME influences. Geomagnetic activity is expected to decline Quiet to Unsettled (Kp 2-3) for days 3 and 4 (17th and 18th).

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux is forecast to remain at predominantly background levels. The high energy electron flux (greater than 2MeV) is expected to start at mainly background levels then likely becoming Moderate to High through tomorrow (16th), and persist at these levels. The associated 24-hour electron fluence is expected to remain below the Active (1e8 integrated pfu) threshold at first, then increase through day 2 (16th), and then probably reach the Active threshold during days 3 and 4 (17th and 18th).

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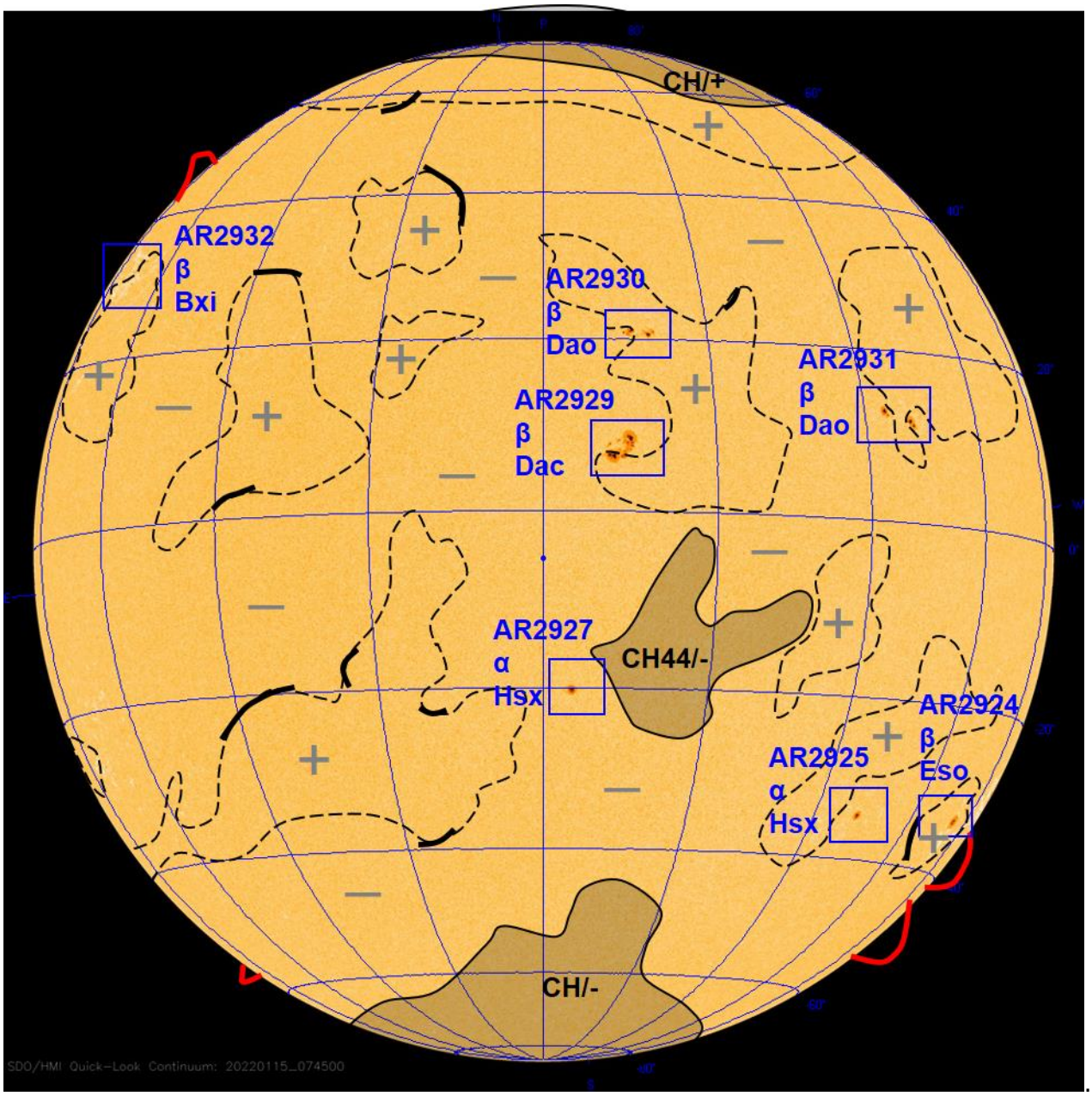
Figure 1. Solar Analysis Valid 15/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

No Earth-directed CME's are currently expected, although the CME associated with the filament lift-off on the afternoon UTC of the 14th, in the southwest quadrant near AR2925, is expected to pass close to Earth late tomorrow or early on day 3 (17th). As confidence is low regarding this CME, there is a chance of weak CME influences at Earth, although these are likely to be masked by the effects of the HSS.

The solar wind is expected increase further through today, likely becoming strong with speeds 600-650 km/s possible. The HSS influence is then expected to gradually decline from day 3 (17th) onwards.

Occasionally Unsettled to Active (Kp 3-4) periods are likely today and through tomorrow, with isolated G1/Minor Storm intervals still possible, especially during the coming night and then to a lesser extend through Sunday night into day 3 (17th) due to possible weak CME influences. Geomagnetic activity is expected to decline Quiet to Unsettled (Kp 2-3) for days 3 and 4 (17th and 18th).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	Yes	60	40	10	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

None currently expected.

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Radio Blackouts - X-Ray Flares:

Solar activity has been Low with several C-Class flares over the past 24 hours, the most recent a C4 flare at 0854UTC this morning from AR2932, at the NE limb. There are 7 numbered sunspot regions currently on the visible disc.

AR2924 is inactive and continues to transit around the southwest limb horizon. AR2925, AR2927 remain small, weak and simple Hsx/Alpha spots. AR2930 has shown significant growth since midnight UTC, now Dao/Beta. AR2929 has continued to grow as a compact group, with the lead spot perhaps showing some very weak Delta configuration, although for now is classified as Dac/Beta. AR2931 has shown only small changes, perhaps widening slightly, Dao/Beta. Recently numbered AR2932 (the source of far-sided flares in recent days), continues to currently emerge around the NE limb, but viewing angle is making definitive analysis difficult at present, currently Bxi/Beta. As mentioned above, it is the source of the C4 flare at 0854UTC this morning.

A further far-side sunspot (ex-AR2918) is also likely to rotate onto the disc within the next two days. This brings an increased chance of M-class flares (R1/R2 Blackouts) and probabilities have been increased a little from day 2 to reflect this.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	30	40	40	40
Very Active	R3 to R5 X Class	No	2	5	5	5

Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as observed by GOES-16 has returned to background levels after a brief very slight enhancement around midnight UTC. Background levels are forecast to continue barring any significant flares or new Earth directed CMEs in the period.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	2	2	2	2
Very Active	≥ S3 *	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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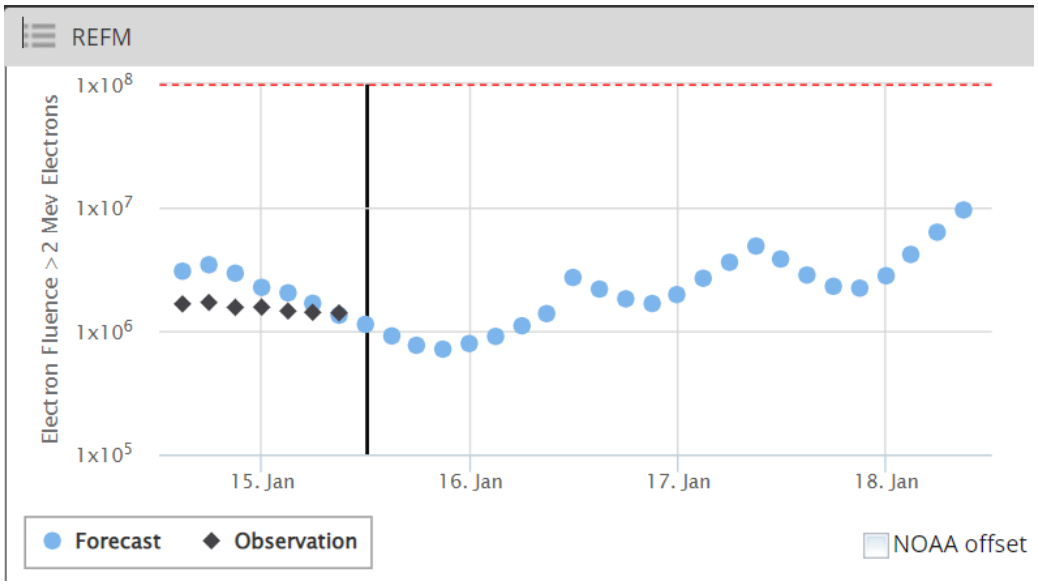
High Energy Electrons Event (≥ 2MeV):

The high energy electron flux (greater than 2MeV) as observed by GOES-16 has been predominantly at background levels, just temporarily observed to reach moderate levels over recent days. Flux levels should begin to rise following the arrival of the fast wind of CH44, and is likely to become Moderate to High through tomorrow (16th), persisting at these levels.
The associated 24-hour electron fluence is expected to remain below the Active (1e8 integrated pfu) threshold at first, then increase through day 2 (16th), and then probably reach the Active threshold during days 3 and 4 (17th and 18th).

The Met Office REFM output is currently giving reasonable guidance, showing the fluence gradually increasing whilst remaining below the Active threshold, during the first 3 days of the forecast period. However, the increase in fluence is expected to be more marked through day 3, with the Active threshold likely to be breached.

GEO Electron Environment	Level ($cm^{-2}\ sr^{-1}\ day^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	10	40	60	80
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	5

Figure 2: MOSWOC REFM.



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